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Doug McElroy
Western Kentucky University, doug.mcelroy@wku.edu

Kate McElroy
Western Kentucky University, kate.mcelroy100@topper.wku.edu

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Cover Page Footnote

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An Evolutionary Perspective on Increasing Student Success, and the (Partial) Fallacy of First-Year Retention

Doug McElroy and Kate McElroy
Western Kentucky University

Halcyon days of growing enrollments and strong state support for higher education are now clearly behind us (cf. Zeig, 2016). With their passing, state colleges and universities have identified student retention as a (if not *the*) key variable in fulfilling their public mission of producing educated citizens as well as ensuring financial sufficiency. An emphasis on student retention is not new; however, the trend of increasing student debt load has brought additional urgency to the issue (American Association of State Colleges and Universities, 2013; Pelletier, 2013; Zeig, 2016). Faculty and staff, university administrators, governing boards, and legislatures are all cognizant of the need to ensure that students accepted into and investing in postsecondary education are supported in ways that maximize their chances to earn a degree or credential. Across the higher education landscape, the imperative has shifted from providing access to one of ensuring success.

The vast majority of attention, effort, and resources directed at improving student retention has focused on the first year of college (Gahagan & Hunter, 2008). Colleges and universities have established a wide range of programs to help students adjust to the postsecondary experience and thus enhance first-year retention; these include first-year courses and seminars (Brownell & Swaner, 2010; Young & Hopp, 2014; Venit et al., 2014), college readiness initiatives (Complete College America, 2012), learning communities and similar co-curricular opportunities (Brownell & Swaner, 2010; Schmidt & Graziano, 2016), and greater emphasis on data analytics to better identify at-risk students (e.g., Bogard et al., 2012; Bogard, 2013; Helbig & Foraker, 2015). These programs are built upon the rationale that helping students successfully make that short-term transition will translate into increased persistence and, ultimately, graduation.

This emphasis on first-year students is understandable, as the transition to college or university life can be daunting for students—particularly first-generation students—and the entering cohort is generally the largest single segment of the student population. While the need to expand retention initiatives beyond the first year is beginning to gain traction (Lipka, 2006; Gahagan & Hunter, 2008; Gore & Hunter, 2010), the number and extent of programs available to support students farther along in their postsecondary careers is generally much less (National Resource Center for the First-Year Experience and Students in Transition). There exists a similar discrepancy in the research literature regarding the efficacy of retention initiatives. A Google Scholar search using the terms ‘first-year retention university’ returned approximately 19,000 articles published in 2016 alone. By contrast, similar searches for second-year and third-year retention yielded about

6,900 and 3,800 articles, respectively, over the same timeframe. However, it may in fact be more advantageous for colleges and universities to pay greater attention to the fate of students at later points in their careers, and to devote more effort and resources to retaining those students.

Here we apply the concept of Reproductive Value (Fisher, 1930) to the question of enhancing student success. We use data spanning 10 first-time, full-time, baccalaureate degree-seeking cohorts at Western Kentucky University (WKU) to explore the dynamics of retention rates, graduation rates, and overall degree production from an evolutionary perspective. We then compare these results to those derived from a sample of WKU's benchmark and peer institutions. We discuss our findings with respect to the following questions: (1) Is there a predictive relationship between first-year retention and subsequent (second-year and beyond) retention and graduation; and (2) What do patterns of student retention indicate about how to best deploy initiatives to enhance specific outcome measures? Specifically, at what point in students' university careers should retention efforts be targeted to maximize the positive impact on graduation rates, and/or yield the largest revenue benefit to institutions?

Methods

Institutional Context. Western Kentucky University (WKU) is one of six state comprehensive institutions in Kentucky, and among eight public four-year institutions in the Commonwealth. WKU is classified in the Carnegie Foundation Basic Classification as an M1 (Master's – Larger) institution. Total enrollment is approximately 20,000, of which 86% are undergraduates. The size of first-time, full-time, baccalaureate degree-seeking (FTFTB) cohort is typically around 2,500. Approximately 75% of undergraduate students are of traditional age (18-24), and nearly 38% are first-generation. WKU's first-year retention rate of the FTFTB cohort is 72-73%, and the six-year graduation rate is 51-52%; another 10-15% of FTFTB students transfer and subsequently graduate with the cohort degree from the receiving institution within six years. WKU grants over 2,800 baccalaureate degrees each year (Western Kentucky University, 2016).

Data Sources. The six-year persistence table for WKU's Fall 2005 through Fall 2014 FTFTB cohorts served as the primary data source for this study. This table included the percentage of the FTFTB cohort retained, graduated, transferred, and not retained each year for up to six years, through the end of the 2015-16 academic year. These data were provided by the WKU Office of Institutional Research, and reflected official fall census counts.

For comparative purposes, similar data were requested from each of WKU's 18 benchmark institutions, as well as six of the other Kentucky public four-year institutions. WKU's benchmark group is aspirational in nature, and includes public institutions from 11 states. Three of the benchmark schools are Carnegie M1 institutions, while 12 are R2 (Doctoral – Higher Research Activity) and three are R3 (Doctoral – Moderate Research Activity) institutions; four of the six Kentucky institutions are classified as M1, and the remainder are classified as R1 (Doctoral –

Highest Research Activity). From the initial group of 24 institutions, six provided data for this study. Of these, two were M1 institutions, three were R2, and one was R1; four different states were represented among the sample.

The Concept of Reproductive Value. Fisher's (1930) concept of reproductive value (RV) is used in population biology to estimate individuals' expected contribution to the next generation, and thus their relative evolutionary importance, at various ages (Pianka, 1994; Grafen, 2006). This expected contribution (or success) is related to the actuarial survivorship curve for that population (l_x schedule) as well as its expected pattern of offspring production (m_x, or fecundity schedule) (Pianka, 1994). Individuals' RV at any point in time is a function of their probability of surviving to that age and beyond as well as the number of offspring individuals are expected to produce in their remaining lifetime. In a population that is stable in size, RV can be calculated as

$$RV = \sum_{t=x}^{\infty} \frac{l_t}{l_x} m_t$$

(Pianka, 1994), and is often expressed by normalizing RV at a given age to that at birth (t = 0). RV is generally highest at the point individuals have reached reproductive maturity but have yet to produce any offspring, because such individuals have survived to the point of being reproductively successful but have not yet expended any of their lifetime reproductive output. In the context of retention and student success, RV can be used to estimate the contribution or value of students at a given point in their college careers to some performance measure (or currency) of interest, such as cohort graduation rate.

Analyses. Average patterns of retention (l_x) and graduation (m_x) rates for the WKU Fall 2004 through Fall 2014 FTFTB cohorts were used to calculate the expected RV (hereafter designated Relative Value) of students at each point in their baccalaureate career. Year-to-year retention probability was equated with survivorship, and the percentage of the cohort having graduated, expressed as a percentage of the previous year's enrollment percentage (m_x*), was taken to be analogous with reproduction. Under this model, the currency of success is cohort graduation rate.

The impact of increasing first-year vs. subsequent-year retention rates on overall cohort graduation rate and baccalaureate degree production was assessed by separately modelling two different interventional programs, which (1) increased first-year retention rate by five percentage points, and (2) increased third-year retention by five percentage points. In each of these scenarios, there was assumed to be no impact on the graduation rate trajectory as a result of the interventions; that is, the additional students retained were assumed to graduate at the same percentage and rate as the original cohorts. Similarly, there was no interaction between retention during the interventional and subsequent years; that is, it was assumed that increasing first-year retention rate, for example, did not make it more or less likely that the impacted students would be retained in subsequent years.

The relationship between first-year retention and subsequent retention and graduation rate was tested by calculating the correlation (r) among (1) first-year and subsequent-year retention and graduation rates, and (2) between year-to-year changes in first-year retention rate and the second-year (i.e., second-to-third year) retention rate for the same pair of cohorts; given the limited number of comparisons, the strength of these correlations were primarily assessed qualitatively using the coefficient of determination (r^2). Finally, the variation in retention rates within and among years was assessed by calculating the standard deviation (s) and coefficient of variation (CV) around the mean retention rate for the first through fifth years; the coefficient of variation expresses the level of variation independent of the value of the mean and so allows for direct comparison among years.

Identical calculations were conducted using the data provided by WKU's benchmark and peer institutions, to judge the extent to which the WKU findings were generalizable to other institutions. Findings among institutions were qualitatively examined relative to differences in variables such as average cohort size, overall retention and graduation rates, and Carnegie classification to identify any potential contributing factors that might account for observed patterns in the results.

Results

Patterns in WKU retention, persistence, and graduation. Over the 10 cohorts examined, WKU's first-year retention rate varied from 71.34 to 73.68%, and did not show a clear pattern of change over time. Of the students not retained to the second year, approximately two-thirds transferred to other institutions, while the remaining one-third left higher education. At the end of six years, just under 5% of the original cohort was still enrolled at WKU, while approximately 30% had transferred and 15% were no longer enrolled at any higher education institution. The six-year cohort graduation rate ranged from 49.6% to 50.3% (n = 5), and showed an upward trend among more recent cohorts. While six-year graduation rate showed a modest degree of change (+1.3%), WKU's four-year graduation rate increased from 23.3% for the Fall 2005 cohort to 28.5% for the Fall 2014 cohort, with a high of 30.1% for the Fall 2013 cohort; this represented a 22-29% increase over seven years. Table 1 provides summary statistics for these relevant variables.

Patterns in RV among WKU year classes. Relative value (RV) increased from 0.50 for beginning first-year students to a high of 0.85 for rising fourth-year students, and decreased thereafter; the average total RV value of WKU cohorts was 4.09 (Table 2). This pattern reflected the fact that, at WKU, the greatest contribution to the overall cohort six-year graduation rate occurred among fourth-year students; on average, 53.6% of all cohort students destined to graduate within six years did so during the fourth year (26.8% out of 50.0%; Table 1). Expressed as normalized RV, fourth-year students' RV was 68% higher than that of first-year students, and the RV of sixth-year students was nearly as high as that of first-year students. This suggests that persistence of students at later points in their careers has a more direct

impact on cohort graduation rate than does that of students at the beginning of their careers, who must generally persist for more years before they can be expected to graduate. Table 2 and Figure 1 summarize the patterns of RV and normalized RV among years.

Table 1. Mean, standard deviation (s) and coefficient of variation (CV) for retention, transfer-out, and graduation rates for WKU FTFTB cohorts by year; data encompass the Fall 2004 through Fall 2014 cohorts. Six-year retention rate represents the percentage of the original cohort still enrolled at WKU after six-years. Retention, Transfer-Out, and Graduation percentages do not sum to 100%; the difference represents that percentage of the original cohort not retained in higher education.

	Retention Rate			Transfer-Out Rate			Graduation Rate		
Year	Mean	s	CV	Mean	s	CV	Mean	s	CV
First	72.61	0.80	0.09	17.70	2.53	0.60	0.00	0.01	0.20
Second	63.82	0.58	0.07	23.59	2.49	0.51	0.06	0.05	0.21
Third	58.06	0.93	0.12	26.81	2.06	0.40	0.90	0.54	0.57
Fourth	29.20	2.42	0.45	28.08	1.50	0.28	26.81	2.19	0.42
Fifth	9.51	1.49	0.48	28.64	1.54	0.29	45.30	1.30	0.19
Sixth	4.76	0.18	0.08	30.57	1.61	0.29	50.01	0.27	0.04

Table 2. RV and normalized RV for WKU FTFTB cohorts by year; data encompass the Fall 2004 through Fall 2014 cohorts. RV drops to zero among seventh-year students, as these students no longer contribute to the cohort graduation rate.

Year	RV	Normalized RV
First	0.5034	1.0000
Second	0.6878	1.3662
Third	0.7816	1.5527
Fourth	0.8448	1.6782
Fifth	0.7922	1.5738
Sixth	0.4833	0.9701
Seventh	0.0000	0.0000
Total	**4.0931**	

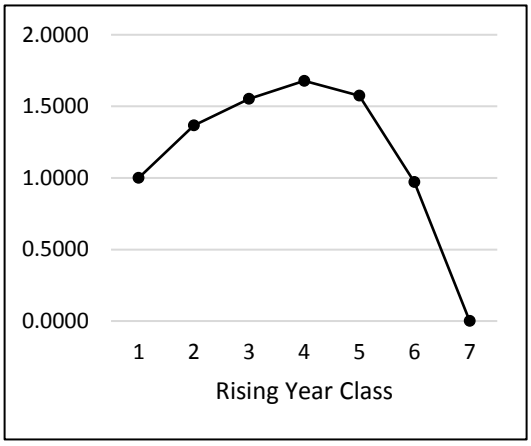

Fig. 1. Normalized RV by rising year class for WKU Fall 2004 through Fall 2014 FTFTB cohorts.

Impact of first- vs. third-year interventional programs. Models of the effect of interventional programs targeted at students at different points in their undergraduate careers indicated that targeting increased retention of third-year students to the fourth year led to a greater positive impact on cohort graduation rate than did programs aimed at first-year students. In fact, the impact of third-year retention programs was greater than programs directed at any other year class, and

the pattern of impact among years was consistent with the observed differences in RV (Fig. 1); that is, modeling of programs directed at second- or fourth-year retention showed impacts intermediate to that seen for first- vs. third-year programs.

Table 3 summarizes the relative impact of first- vs. third-year programs for a hypothetical university with characteristics similar to WKU. Based on an entering cohort of 3000, increasing first-year retention by five percentage points (i.e., an additional 150 students retained to the second year) yielded an additional 71 degrees at the end of six years; this resulted in an increase in cohort graduation rate from 50% to 52%. By contrast, increasing third-year retention rate by the same magnitude resulted in an additional 88 degrees, and a cohort graduation rate of 53%. While the same number of additional students were retained under each scenario, the fact that third-year students were closer to graduation – and thus had a higher RV – meant they had a more direct impact on graduation rate than did additional students retained near the beginning of their careers. Changing variables such as cohort size, persistence and graduation rates affected only the magnitude and not the pattern of these conclusions.

Table 3 assumes that the same absolute number of students is retained under each intervention scenario – i.e., 150 students or 5% of the original cohort; however; this implies the third-year retention initiative is more efficient at successfully identifying and retaining students. That is, there are fewer students from the original cohort remaining in Year 3, such that the 150 additional students retained represents 7.5% of the students remaining. Maintaining a nominal rate of 5% in the third-year intervention (i.e., 98 additional students retained) results in 57 additional degrees, over 80% of the total gained under the first-year retention initiative, and a graduation rate of 51.9%.

Year-to-year change in WKU first-year and second-year retention. There were no significant correlations between first-year retention and either retention in any subsequent year. Most noteworthy, however, the relationship between first-year and second-year retention was negative ($r = -0.13$, $p = 0.73$, $n = 9$). There was also a non-significant negative correlation between year-to-year differences in first- and second-year retention among WKU FTFTB cohorts ($r = -0.26$, $p = 0.54$, $n = 8$). The coefficient of determination in both cases was low ($r^2 = 0.02$ and 0.07, respectively). Nevertheless, when first-year retention rate was higher or increased from one-year to the next, the subsequent second-year retention rate tended to be lower and/or decrease, and vice versa (Table 4, Fig. 2). These findings suggest that any additional students retained through the first year tended to be lost during the second year; at the very least, the lack of significant correlation suggests that the impact of circumstances that yielded an increase on first-year retention did not have a carryover effect. Taken together, these data imply there existed a more-or-less equilibrium percentage of students likely to be retained at WKU through the second year and into the third; this conclusion is supported by the observation that second-year retention showed the lowest coefficient of variation (CV = 0.07) among any

year class (Table 1). There was also no relationship between first-year retention and six-year cohort graduation rate ($r = 0.21$, $p = 0.92$, $n = 5$, $r^2 = 0.04$).

Table 3. Impact of first- vs. third-year intervention programs for a hypothetical university. In each case, the interventional program is assumed to yield a five percentage point increase in retention rate (Retention rate +) to the next year. Increased retention in subsequent years is based on the baseline attrition rate.

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Baseline						
Retention rate (%)	100.00	75.00	65.00	60.00	35.00	10.00
Graduation rate (%)	0.004	0.05	0.60	25.00	45.00	50.00
N Retained	3000	2250	1950	1800	1050	300
N Graduated	0	2	18	750	1350	1500
First-Year Intervention						
Retention rate + (%)		5.00	4.33	4.00	2.33	0.67
N+ Retained		150	130	120	70	20
N+ Graduated			1	29	31	10
Total Retained	3000	2400	2080	1920	1120	320
Total Graduated	0	2	19	780	1411	1571
Graduation rate (%)	0.00	0.05	0.63	26.00	47.03	52.37
Third-Year Intervention						
Retention rate + (%)				5.00	2.91	0.83
N+ Retained				150	88	25
N+ Graduated				36	39	13
Total Retained	3000	2250	1950	1950	1138	325
Total Graduated	0	2	18	786	1425	1588
Graduation rate (%)	0.00	0.05	0.60	26.20	47.50	52.93

Table 4. Comparison of changes in first-year and second-year retention for WKU FTFTB cohorts; data encompass the Fall 2004 through Fall 2014 cohorts.

Comparison	Change in First-Year Retention Rate	Change in Second-Year Retention Rate
2005 - 2006	-0.68	-1.32
2006 - 2007	-0.82	1.48
2007 - 2008	1.64	-1.01
2008 - 2009	0.02	-0.27
2009 - 2010	-0.50	0.93
2010 - 2011	-1.84	-1.17
2011 - 2012	0.38	0.56
2012 - 2013	1.35	-0.29

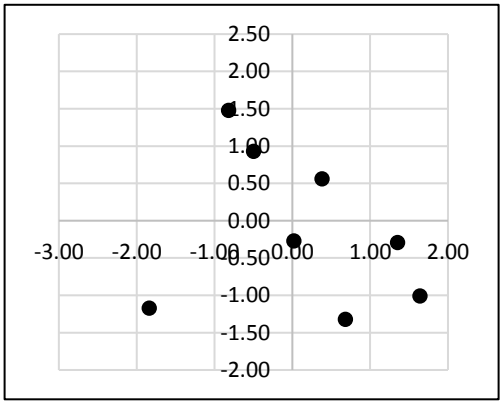

Fig. 2. Year-to-year change in first-year (x axis) and second-year retention rate (y axis). $r = -0.26$, $r^2 = 0.07$.

Comparison with benchmark and peer institutions. Patterns of RV among the six benchmark and peer institutions showed very similar patterns to WKU. At all institutions, RV rose from the first-year up to the point that students began to graduate in significant numbers, and decreased thereafter. Among beginning-year students, RV ranged from 0.36 to 0.68; total RV ranged from 3.30 to 4.68. Five of the six schools showed the highest level of RV among fourth-year students; one institution's highest RV occurred in year five. In all cases, the highest RV occurred in the year that the greatest percentage of students graduated. Fig. 3 shows patterns of normalized RV among all institutions.

When expressed as normalized RV (Fig. 3), there was an inverse relationship between total RV and the vertical positioning of that institution on the graph; that is, the school with the highest total RV appears at the bottom of the stack, and vice versa. This is because higher overall graduation rates serve to increase the value of RV across all year classes, leading to a higher RV for beginning-year students and a flatter distribution overall.

Fig. 3. Normalized RV by rising year class for all seven institutions examined. Data for WKU are shown with a dotted line.

In contrast to WKU, the relationship between first-year and second-year retention was positive for each of the six other institutions examined; correlation coefficients ranged from 0.577 to 0.942. Four of the six comparisons were significant based on Bonferroni-adjusted criteria (p_{crit} = 0.008), and five of six displayed p-values $\leq$0.05. Similarly, data from all six institutions exhibited a positive correlation between first-year retention and six-year graduation rate; individual correlations were high (r values ranged from 0.629 to 0.863) but, because of the limited sample sizes in each comparison (n= 3 to 6) none were significant at even an uncorrected p_{crit} of 0.05. Four of the six institutions showed the least variation in retention rates, i.e., lowest coefficient of variation, during the first-to-

second year. Two institutions, like WKU, showed the lowest CV for second-to-third year retention.

Discussion

Is enhanced first-year retention predictive of increased subsequent-year retention and/or graduation rates? At most institutions studied, higher values of first-year retention rate among cohorts were associated with higher levels of second-year retention; WKU was a clear exception in this regard, as there was a negative, though non-significant, correlation between these two variables. In a similar way, while the positive correlation between first-year retention and six-year graduation rate at WKU was weak, the positive relationship between these variables at other institutions was much stronger, though still non-significant due to limited sample sizes.

Overall, then, it is reasonable to assume some carry-over effect of greater first-year retention, WKU notwithstanding. However, the WKU example highlights the need to understand the particular persistence dynamics of an institution prior to designing interventions. This is true for the entire cohort, but a similar caveat applies to any demographic subset that might be targeted for intervention; while trends may well exist, there is no *a priori* reason to assume that a given subset of students (e.g., underrepresented minority, non-traditional, low socioeconomic status) will necessarily show the same pattern as another or as the entire cohort. Given that such variances may impact return-on-investment, it is prudent to examine such patterns during the design phase of an intervention program.

When should interventional retention programs be targeted to maximize impact on graduation rate? Despite the above, both the patterns of RV and the models of interventional programs targeted at specific year classes of students indicate that increasing retention of students at later points in their careers has a more direct impact on both the number of degrees awarded and the cohort graduation rate than do similar programs targeted at first-year students. In particular, the biggest impacts are seen when targeting groups of students who will account for the largest percentage of the total number of cohort graduates the following year. At WKU, this corresponds to rising fourth-year students, and either fourth- or fifth-year students at the benchmarks and peer institutions sampled.

While overall retention and graduation rates are key variables for most institutions, there are multiple ways that these may be addressed through interventional programs. For example, reducing transfer-out rate could be directly targeted, as means of indirectly impacting retention at the native institution (Hoyt & Winn, 2004). Alternatively, efforts might center on ensuring students are appropriately progressing towards degree completion, through initiatives to ensure appropriate advising and timely declaration of major (Foraker, 2012; Sklar, 2013). Finally, programs might focus on aspects of student support, such as advising, financial aid, counseling and mentoring, or family life, designed to reduce barriers to students path to degree (Hoyt & Winn, 2004). In all cases, it is important to recognize and understand the dynamics of the different subsets of non-retained

students that exist (Hoyt & Winn, 2004), and to design interventional programs accordingly. It is important to recognize that the design, motivation, and specific targeted outcomes of such programs may be diverse in nature. Nevertheless, as all of these approaches will ultimately impact the same high-level metrics of retention and graduation rate, the underlying principles of RV and relative contributions of age-classes to the outcome of interest described herein should apply.

In addition to yielding a greater output in terms of degree production, focusing on students closer to graduation may have benefits in terms of institutional efficiency as well. It may be easier to identify students who are at-risk for not being retained to the next year but might in fact benefit from a targeted intervention program, for several reasons. First, there are a smaller number of cohort students remaining in later years to be screened or evaluated for risk. Second, more data are available on these students, as they have a longer institutional and performance history, making assessments of risk more accurate (Bogard et. al, 2012; Bogard, 2013). Third, there may be fewer, or a narrower range of, variables still in play that could negatively impact their continued persistence. Finally, to the extent that a single point of intervention may not be a magic bullet, resources and services do not need to be directed at such students for as many years as would be the case if intervention began earlier on in their careers. Even if the absolute number of additional students retained and graduated is less, taken together these circumstances might be expected to yield a greater return on institutional investment of effort and resources.

While the persistence and graduation of students is paramount, it is important to recognize that revenue variables are also critically important as institutions develop and implement strategic initiatives to fulfill their public missions. Our findings indicate that focusing on retention and persistence of students closer to graduation is more impactful in terms of key measures of student success such as degree production and graduation rate. However, if the primary currency of success is total tuition revenue, then the story is quite different.

Using the data in Table 3 to calculate total revenue shares generated (one revenue share equaling tuition and fees paid by one student for one year), a first-year intervention program would generate 4.7% additional revenue over the six-year period of a single cohort, whereas a third-year intervention program would generate an additional 2.5% in revenue. Similarly, programs that reduce the time to degree completion, while benefiting students through reduced student debt and earlier access to the workforce, will likely reduce total enrollment at and thus revenue to the institution. Finally, as performance-based funding becomes more prevalent (American Association of State Colleges and Universities, 2011), it is important to evaluate the funding gains to be earned through increases in a performance metric against the likely costs associated with producing an increase of that amount. Given this strategic dichotomy, it is important for institutions to go into any planning process with a clear sense of the outcome variable(s) to be maximized, or at least of the potential trade-offs that may exist.

Is it possible to have it both ways? The simulations presented assume no synergistic effects on first-year retention and retention in subsequent years; that is, the attrition of the extra students retained during the first year occurs at the same rate as that of the entire cohort. However, it is possible that addressing at-risk students' impediments during Year 1 might fundamentally change their likelihood of being retained throughout their career, i.e., move them into a higher retention probability bracket. To investigate this possibility, we modified the simulations to assume an interventional impact across multiple years. While any such carryover effect increases degree production and graduation rate (as well as revenue), only by retaining 100% of impacted students into the fourth year was it possible to yield outcomes equal to or greater than that seen as a result of third-year interventional programs. As such, it appears that there is always an advantage to addressing at-risk students closer to graduating.

RV can serve as a more general model for strategic decision-making. Our results seem to suggest four general principles that should be applied when designing intervention programs to enhance student success:

1. The biggest impact will be gained by investing resources on students closest to achieving the performance outcome of interest.
2. Doing so may also be more efficient in terms of return-on-investment, as there will be
    a. a smaller pool of students needing evaluation and support; and
    b. more information available to assess the level of risk for each student.
3. In making decisions about how to proceed, it is important to understand the persistence dynamics of the particular set of students being targeted.
4. The optimal approach depends on the primary outcome of interest, and maximizing success in that dimension may not maximize success in other, related dimensions.

While we have applied the concept of RV to persistence and graduation metrics, the same principles can be applied to any strategic decision-making process for which (1) there exist discrete entities, that are (2) connected by forces and processes influencing their make-up and behavior, and (3) we can evaluate success and change over time using measurable currencies or outcomes of interest. For example, one could use this model to evaluate the impact of alternative curricular designs or pathways on enrolment and majors, approaches to promoting external grant support, or strategies to access a larger share of performance funding.

In all cases, identification of the primary outcome of interest is in many ways of most importance, as it can lead to very different results. This is illustrated by the difference in best approaches to enhancing student persistence and success, depending on whether graduation rate or total revenue serves as the primary outcome of interest. Here, application of the RV concept yields different solutions (i.e., intervening in the third vs. the first year). Rather than suggesting an inconsistency in the model, it in fact highlights the dependence of the results to selection of the outcome of interest. In the case of graduation rate, an investment in

first-year students is unlikely to return in the form of increased degree production until several years later, whereas investment in third-year students yields a significant return the following year. Tuition revenue derived from additional first-year students retained, however, is realized during the second year (and for several years beyond that for students who continue to persist) and, as such, it makes the most sense to invest in those first-year students. This decision regarding the outcome of interest can in itself be a complex process, as there are generally multiple overlapping, and sometimes conflicting, priorities in play, and so it is especially helpful to have a set of objective criteria upon which to base this determination.

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